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ASSOCIATION OF 2D:4D RATIO WITH PERFORMANCE IN RACQUET SPORT PLAYERS

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Abstract:
The ratio between index finger and ring finger has been found to be a major contributing factor in many sports. Studies have suggested that 2D:4D ratio is negatively correlated with prenatal testosterone, which is further related to superior sports performance. Hence, the present study is a further development in this direction and tries to explore the association of 2D:4D ratio with grip strength and performance in racquet sport players. 45 Racquet sport players from various academies were measured for 2D:4D ratio, hand grip strength, maximum anaerobic power, and agility and performance level. It was found that 2D:4D ratio was positively correlated with agility and negatively correlated with hand grip strength and maximum anaerobic power. However, no statistically significant relationship was found between 2D:4D ratio and performance in racquet sport players. The significant results can be investigated further for talent identification and sporting abilities in Racquet-sport players.

Keywords: agility, handgrip strength, maximum anaerobic power

1. Introduction

Racquet sports, is an umbrella term used for sports played, using handheld instruments and includes badminton, table tennis, lawn tennis, squash etc. It requires the player to couple the hand with the racquet in order to strike the ball. It is a highly demanding game, which requires strong physical, physiological and psychological attributes for a superior performance [1].

The physical traits which are predictors of paramount performance for racquet players are grip strength, speed, agility and power. In tennis, agility, running speed and neuromuscular power were reported to be primary determinants of performance [2]. In

addition, Jaworski and Zak [3] found that among 7 variables of right grip strength, left grip strength, sit-ups, push- ups, agility, leg strength and flexibility, grip strength was the most and flexibility the least important parameter for performance in tennis. Also, the velocity of the ball following the impact may be affected by grip strength in racquetball [4].

Handgrip strength as Shyamal and Srikanth, [5] have defined is maximum force a subject can exert voluntarily to forcefully flex all the fingers under normal bio kinetic conditions. Handgrip strength (HGS) is a good predictor of muscle strength and function [6]. It has been proven that grip strength has a positive effect on sports performance in which a sporting instrument is grasped in the hand [4]. Forearm and hand muscles strength is necessary for strong grip strength which is required for holding racquet. It is also believed that whole body strength can be predicted from grip strength [7].

Agility also forms an essential component for sports performance. Agility is dependent on strength, power, balance, coordination and reaction time. Agility can be defined as the ability to move and change direction quickly and effectively. Paul M[8] have reported that higher scores on performance evaluation were achieved by agility trained tennis players, in comparison to those receiving normal tennis training. Hence, depicting that improved agility translates into improved tennis performance.

Another major component for racquet sports is Anaerobic Power. The capability of utilising phosphagenic system can be termed as anaerobic power. This ability of utilizing phosphagenic system efficiently leads to move the body at the fastest possible pace, in no time. Racquet sports require rapid movement of legs in the field to hit the ball/shuttle and for these instant dynamic contractions of lower limb muscles energy is supplied through the phosphagenic system.

Besides these components, 2D:4D ratio (digit length) is another variable. The ratio between the phalanges of second finger and fourth finger is widely known as the digit ratio (2D:4D). It is associated with the amount of hormone testosterone exposed in the mother's womb during prenatal period. Low digit ratios have been associated with higher prenatal testosterone exposure, which is further related with good performance in sports [9].

2D: 4D ratio has been found to be a major contributing factor in determining performance in many sports. Mohd Zulkhairi et al [9] have determined the relationship between 2D:4D with Agility in male youth sport players in general. Lower left hand digit ratios in elite female athletes were found to be positively associated with sports potential. In addition, Leszek Pokrywka, et al[10] found that elite female sportsperson had lower 2D:4D ratio, in comparison to those who never participated in sporting activities and concluded that low 2D:4D ratio may be positively correlated to sports potential of female athletes. This was seconded by Paul S.N et.al [11] who reported that participants with low 2D: 4D ratio had better running and sporting capability.

Furthermore, 2D: 4D ratio was also postulated to improved performances in different sports. A negative correlation was reported between 2D:4D ratio and

Endurance running in men and women [12]; rowing performance [13]; rugby performance [14]; greco-roman wrestling [15]; Indian male Kabaddi players in comparison to non-athletes [16]; sprint time and reaction time in sprinters. [17]

Sports performance is based on a complex and intricate diversity of variables which play a significant role in determining the performance level and there have been many studies establishing the association of 2D:4D ratio with superior sports performance, but none of the studies have investigated the association of 2D:4D ration in racquet players. Hence, present study is a further development in this direction and tries to find out the association of 2D:4D ratio with grip strength, agility, anaerobic power and performance of racquet players.

2. Methods

All procedures and protocols were approved by the Institutional Review Committee for the ethical participation of human subjects. The participants were explained about the procedure individually and then the consent form was duly signed by them. They were also asked to fill the necessary details in the assessment form like name, age, gender, address, contact number, dominant hand, sport played, level and medical history. Height was measured in centimeters using a stadiometer. Participants looked straight ahead with their arms hanging by their side and a bar was brought down to the top of the head to record the height. Weight was measured in kilograms using a weighing machine and the participants were in minimal clothing with shoes off. The weighing machine was calibrated each time before measurement. Participants were told that they could withdraw from the study at any time without any penalty. Forty five Racquet players, both males and females were drawn from various sports academies (age 20 ± 1.94 years, height 171.76 ± 9.60 cms, weight 61.87 ± 11.49 kgs). Any player taking performance enhancing drugs or having musculoskeletal injury/surgery was excluded from the study.

3. Procedures

Following tests were performed by the subjects to measure the parameters:

A. 2D:4D ratio

Subjects were instructed to put both their hands, fingers together, on the surface of a scanner [15] (Hp Deskjet Ink Advantage 2515). Scanned images were saved as pdf documents. The tip of the finger and ventral proximal crease were taken as the reference points for measuring the length of second (2D) and fourth digits (4D) of the dominant hand. The measurements were taken using measuring tool in adobe and 2D:4D ratio was computed using Microsoft Excel. [6]

B. Handgrip tests

Muscular strength and endurance was measured using hand grip dynamometer. The reliability of Jamar Dynamometer was 0.98 and validity was 0.99. [18]

First, the participants were asked to perform Maximum Voluntary contraction (MVC) task, for which, they sat comfortably on chair with feet placed shoulder width apart on floor, both hips and knees flexed in 90 degrees, back straight, elbows shoulder width apart resting on the table. They were then asked to press the dynamometer with dominant hand in supination and non-dominant hand in pronation with dynamometer being directly in front of them. Subjects were asked to press the dynamometer with maximum force for 3 seconds. The experimenter started the stop watch as the subject reached maximum grip strength and noted the readings after 3 seconds.

The MVC task was followed by a brief rest, after which MET trial was administered. MET, reflects local muscular endurance. The participants sat in the above mentioned position and squeezed the dynamometer at 70% of their respective MVC and held it for as long as they could. The researchers noted the timings with a stop watch when the participant reached 70% of their MVC to the time it had fallen below 70% of MVC. Then, a second recording was taken, about which participants were not informed prior, to prevent them from preserving strength for the second trial. [19]

C. Agility- T-test

Agility was assessed by T-test. The reliability of the T-test in men was 0.97 and 0.90 in women. [20]

Four cones (A, B, C and D) were placed on the ground in 'T' shape. Three cones (B, C and D) were placed five meters apart in a straight line. While, the fourth cone (A) was placed 10 meters away from the middle cone (B). Subjects began with both feet behind the starting line 'A'. At his or her own discretion, each subject sprinted forward to cone 'B' and they were asked to touch its base with their dominant hand. Facing forward and without crossing feet, they shuffled to the left to cone 'C' to touch its base with the left hand. Subjects then, proceeded to the right to cone 'D' & touched its base with the right hand. Thereafter, they shuffled back to the left to cone 'B' to touch its base. Finally, subjects ran backward as quickly as possible and returned to line 'A'. Any subject who crossed one foot in front of the other, or failed to touch the base of the cone, and/or failed to face forward throughout the task had to repeat the test. [20]

Total duration of completing the entire task was recorded in seconds using the stop watch.

D. Maximal anaerobic power (MAP)

It was calculated as the product of body mass and standing long jump. [3]

Long jump was measured by drawing a start line on the track with chalk and the subjects were instructed to stand behind the line and jump 3 times. The distance was measured from the starting point till the end point using a measuring tape of all the trials. The best reading was taken to calculate MAP.

3.1 Performance evaluation

The coaches were asked to rank the participant we's competitive level in the sport on a scale from 1 to 10, with 1 representing no participation in sports and 10 representing international level participation.

3.2 Data Analysis

All data is presented as mean values and standard deviations (M±SD). Data analysis was done with the help of SPSS for windows version 22.0 in order to verify the investigations of the study. Mean and standard deviation of all the variables were analysed. Pearson's correlation test was used to find out the relationship of 2D:4D with hand grip strength, maximum anaerobic power, agility and performance in Racquet sport players.

The confidence interval was accepted as $p<0.05$, $p<0.01$ and $p<0.001$.

4. Results

The mean age, height, weight and 2D:4D Ratio of 45 players were found to be 20 ± 1.94 years, 171.76 ± 9.60 cms, 61.87 ± 11.49 kgs and .95 ± .04 inches respectively.

A. Relationship of 2d:4d with Agility

The mean value of agility was 12.43 ± 1.50 secs (see table 1).There was a positive correlation found between agility and 2D:4D ratio with r value = 0.32, p value <0.05 (See table 2).

B. Relationship of 2d:4d with Grip Strength

The mean value of MVP was 30.51 ± 9.11 kgs and MET was 13.51 ± 8.83 secs (see table 1). Although a significant negative correlation was found between MVC and 2D:4D ratio with r value = 0.46, p value < 0.001 (See table 2). However no statistically significant correlation between MET and 2D:4D ratio with r value = 0.21, p value = 0.161 (see table 2)

C. Relationship between 2D:4D with Map

The mean value of MAP was 14864.33 ± 3310.13 kg-cm (see table 1). A negative correlation was also found between MAP and 2D:4D ratio with r value = 0.36, p value <0.05 (see table 2).

D. Relationship between 2d:4d with Level of Performance

The mean value of performance level was 6 ± 2.83 (see table 1). There was no statistically significant correlation between level of performance and 2D:4D ratio with r value = 0.19, p value = 0.22 (see table 2)

5. Discussion

In the field of sports, the players have been always identified on the basis of technical skills.

It is only in the recent years, that researches have begun identifying kinanthropometric variables which could predict performance at an early age, so that the young athlete can be nurtured in a medal winning performer. 2D:4D ratio is one such variable which has been known to be associated with high performance. The purpose of the present study was to investigate correlation between 2D: 4D ratio with performance in racquet sports. To evaluate performance in racquet sports, agility, grip

strength, maximum anaerobic power and rating of performance by coach were implemented.

The present study revealed a positive association between 2D:4D and agility. The negative correlation between 2D:4D and MVC, MAP were reported. However, no statistically significant relationship was found between 2D:4D and MET & performance scores given by the coach.

A positive correlation between Agility and 2D:4D ratio implies that players with higher 2D: 4D took more time in completing the agility task. This contradicts the previous finding by Slawomir Koziel et al [21] in polish men in whom agility was measured by 5x10 m shuttle run test. Since, sprint speed and reaction time are both components of agility and have been shown to be related with 2D:4D by Manning [22] ; Tambe MK [17] , the positive correlation of agility outcome could be attributed to better sprint speed and reaction time in athletes with low 2D:4D.

Previous studies have reported a strong negative correlation between handgrip strength and 2D:4D. This finding is supported by the current study. However, no statistically significant correlation of 2D:4D ratio and MET scores of the players were found. Both the outcomes support the findings by Hone and McCullough. [21]

Furthermore, a negative correlation between 2D:4D ratio and MAP was reported in the present study. The MAP was calculated as a product of body mass and standing long jump in the study. The negative correlation of MAP, grip strength and 2D:4D ratio could be due to prenatal androgen exposure and related improvement in muscle strength and power.

Though we found that 2D:4D ratio is associated with Hand Grip Strength, Agility and MAP which are crucial markers for a superior performance in racquet sports but there was no statistically significant correlation between level of performance and 2D:4D ratio was reported.

5.1 Recommendation

The study was an attempt to establish 2D:4D as a kinanthropometric tool in selection of players in racquet sports, but no statistically significant relation was found between racquet sports performance and 2D:4D, this might be because the smaller representation of each participants from each level. Also, the participants belonged to different sports which could have affected the outcomes of performance evaluation scores by the coach. Hence, future work must focus on larger representation of players from different performance levels involving one particular racquet sport.

6. Conclusion

The purpose of the present study was to find the association of 2D:4D with racquet sport performance. While, no significant correlation between 2D:4D and Racquet sport performance was observed, correlation between 2D:4D and important markers of performance in Racquet sports i.e., agility, MVC and MAP was reported in the present

study. Evidences from present study are insufficient either to accept or reject the hypothesis. Hence, further work to investigate the potential of 2D:4D in predicting performance in racquet sports and its possible usage in selection of talented players in racquet sports is recommended.

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Appendix

Table 1: Mean and Standard Deviation of 2D:4D ratio, MVC, MET, MAP, Agility and Level of Performance

Variables	Mean ± Standard Deviation
2D:4D Ratio	.95 ± .04 inches
MVC	30.51 ± 9.11 kgs
MET	13.51 ± 8.83 secs
MAP	14761.93 ± 3251.82s kg-cm
Agility	12.43 ± 1.50 secs
Level of Performance	6 ± 2.83

**Correlation is significant at the 0.01 level (2-tailed).

Table 2: Correlation between 2D:4D ratio and MVC, MET, MAP, Agility and Level of Performance

Variables	r-value	p-value
MVC	-.46**	< 0.01
MET	-.21	0.161NS
Agility	-.36*	<0.05
MAP	.32*	<0.05
Level of Performance	-.19	0.22NS